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MAINFRAME

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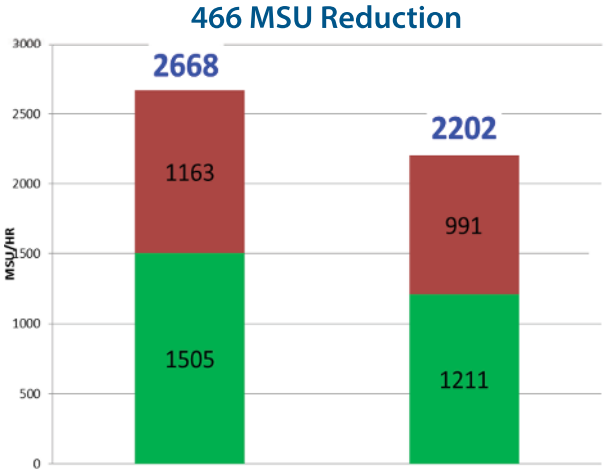


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## WE ASKED OUR CONTRIBUTORS:

### Summer movie season is beginning. Who would play you in a movie of your life?

**Greg Lotko:** A younger Perry King

**Elizabeth Reddall:** Laura Linney with dark hair

**Holly Eamon:** Tina Fey

**Steve Mathewson:** Chris Elliot

**Nicole Johann:** Rachel McAdams

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# EDITOR'S DESK

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## Flexible and Agile Environment

Hot yoga—where the room temperature is turned up to increase flexibility and mimic conditions found in India—is my favorite fitness activity. I prefer the fast-paced aerobic yoga style known as power vinyasa, as it tests the flexibility and agility of my muscles and mind. At the end of the session I feel a stronger sense of personal performance, as if my body is as tuned and efficient as possible.

Those same attributes can be said of Linux* on z Systems*, and longtime supporter IBM is providing more enhancements and solutions for the open-source platform for the enterprise.

In the cover story on page 18, find out how IBM is helping customers face today's demands in a hybrid cloud by leveraging APIs and microservices on the platform. The feature on page 22 examines the advantages of Linux on IBM z* versus scale-out servers running core business workloads, and Currents on page 11 explains how the new IBM z13s* server can consolidate Linux workloads at a lower cost.

Also in this issue, learn how IBM Multi-Factor Authentication for z/OS* helps maintain a secure infrastructure on page 44. And meet Connor Krukosky, a young man installing a z890 in his parents' basement, in Stop Run, 48.

Like IBM's commitment to Linux on z Systems, my commitment to my yoga practice enables me to perform with increased flexibility and agility. As more demands are placed on the Linux on z Systems platform, these attributes will become increasingly important.

Valerie Dennis // Managing Editor
*vdennis@msptechmedia.com*

## CONTRIBUTORS

### Gabe Goldberg

**Nonprofit Volunteer**

Gabe Goldberg, author of Stop Run on page 48, has never resisted the siren song of nonprofit organizations. He has given time to SHARE and Hillgang user groups and various technology groups, served as an officer of his police station's Citizens Advisory Committee, and enjoyed being on the board of directors of a small professional theater company. The more time and effort he spends volunteering, the greater return he experiences.

### John Davis

**Balancing Act**

John Davis, photographer for Stop Run on page 48, lives in his adopted hometown of Baltimore, Maryland, with his wife, daughter and cat. He believes that shooting only film when he started out was integral in the evolution of his creative eye and that by slowing down the process of seeing, the mind is able to process more deeply. As a true Libra, he's all about balancing his artistic self with his inner athlete by running marathons—15 so far—and playing ice hockey in a local men's league.

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# IBM PERSPECTIVE

## Elevating Open Source for the Enterprise

IBM has long been a champion of Linux* and the collaborative environment for technology development it supports. We first offered Linux on the IBM z Systems* platform more than 15 years ago and have seen its use grow to more than a third of our clients.

Our commitment to Linux is only getting stronger as we enter the new era of hybrid cloud where organizations combine on-premises systems with the public cloud. Last year we launched IBM LinuxONE*, the world's most advanced line of Linux OS-only systems.

IBM also enabled new open-source and ISV software for z Systems*, including Apache Spark, Node.js, Docker, MongoDB, MariaDB and PostgreSQL. More than 3,000 Linux applications can now run on IBM z Systems.

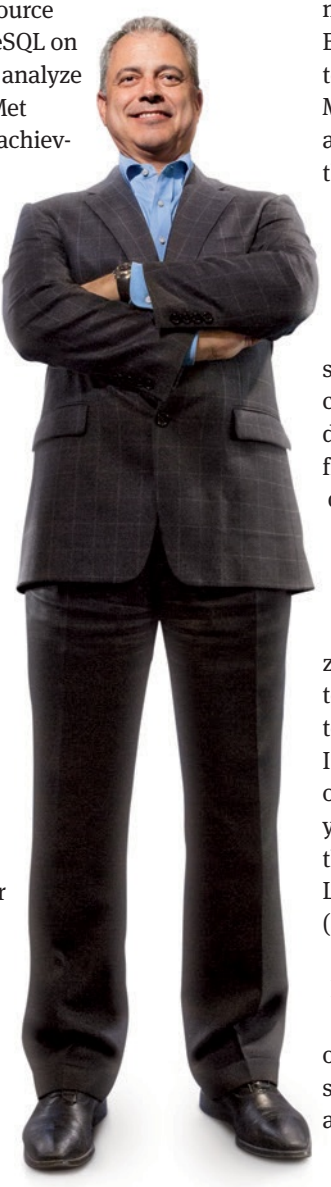
This year, the ecosystem for IBM z Systems and LinuxONE continues to expand. We've optimized StrongLoop* and Cloudant*, making it easier to develop applications and access data. We've ported the Go language to the system and are contributing code back to the community.

In addition, the company is already exploring ways to use blockchain open-ledger technology on IBM z Systems and LinuxONE to transform the way businesses process and reconcile complex contracts and transactions.

These advances are promising because they eliminate the trade-offs many organizations had previously accepted. Organizations now have the agility and flexibility of open-source software along with the speed, scale and security of IBM z Systems and LinuxONE.

The U.K. Met Office is taking advantage of the combination as it analyzes millions of data points each day to develop its forecasts. It's using open-source relational database PostgreSQL on IBM z Systems to store and analyze that data. This allows the Met Office to lower costs while achieving the speed and availability required to deliver forecasts that help save property and lives.

LinuxONE also is providing an attractive option to companies new to the platform. Huaxia Express Technology Development Co. is using LinuxONE to deliver a new e-ticketing solution for a major passenger bus line in China. Nanchong Dangdai Transport passengers will have the convenience of buying tickets through a website, mobile app or even the WeChat social media channel. The new system will help the transport firm better understand customer needs and trends.



PHOTOGRAPHY BY BILL BERNSTEIN

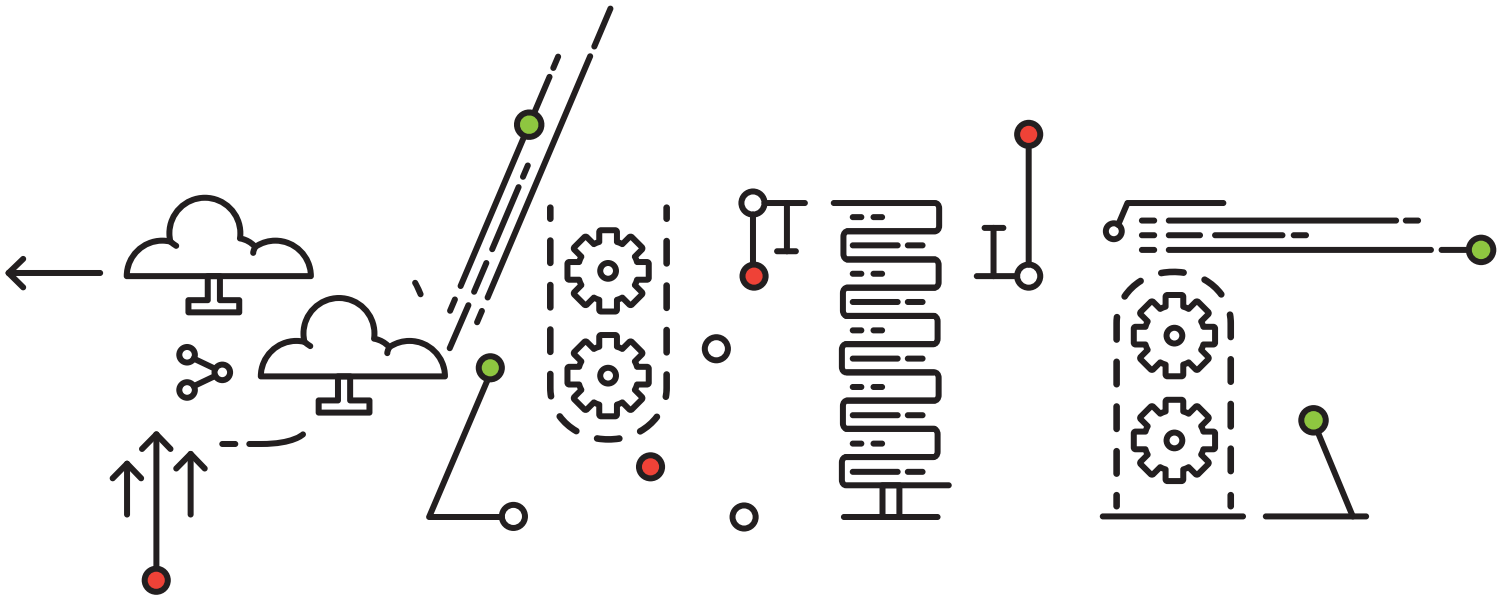
**ROSS A. MAURI**
General Manager,
IBM z Systems and
LinuxONE

To enable more solutions like these, IBM plans to continue an aggressive expansion of the z Systems ecosystem and look for new ways to foster collaboration. Earlier this year, IBM contributed to the Linux Foundation Open Mainframe Project the code for an anomaly detection engine that can help detect system issues and prevent failures before they happen.

The LinuxONE Community Cloud, which provides test-drives of the LinuxONE system at no charge via the cloud, attracted more than 500 developers in 72 countries in its first three months. It's allowing developers to explore and create new applications with unprecedented access to the platform.

If your organization is already running Linux on z Systems, now is the time to start looking at new ways to leverage your investment. If you're not running Linux on z Systems, encourage your developers to check out the capabilities through the LinuxONE Community Cloud (developer.ibm.com/linuxone).

The list of open-source and ISV software on IBM Systems continues to grow, providing options that can help take your system to new levels of flexibility and performance.



# INFRASTRUCTURE Intelligence

## New information about threats in the z/OS system improves performance

Leaders without access to accurate intelligence could eventually cause significant harm through their actions—or lack of timely action.

**Brent Phillips** is the managing director of Americas for IntelliMagic. He has been working in IBM mainframe environments in technical and business roles for more than 30 years, and since 2005 in this role with IntelliMagic.

Despite massive investments, IT and business line leaders still don't have up-to-date intelligence about the hidden threats to IT infrastructure performance likely to harm the continuous availability status of their business applications. As a result, unpredicted performance and availability issues keep occurring.

### Increase Visibility

Problems are often discovered after services for production applications have been disrupted, and IT staffers are forced to react in emergency mode without adequate preparation and planning. IT and business leaders can learn about upcoming problems through easy visibility into the leading indicators about how well technology infrastructure components are handling business application workloads. This way, the problems can be resolved before they impact application users and transactions.

Historically, IT leaders have attempted to protect the continuous availability status of the technology infrastructure primarily through disaster recovery (DR) initiatives, such as replication and redundancy. While DR is critical, unexpected performance problems are the most common reason users and transactions are disrupted.

The complexity of information system architectures and the less predictable nature of mobile users make it more difficult than ever for today's reduced IT staffs to ensure the infrastructure has the performance capacity to handle the business workloads without disruptions.

### Monitor Root Causes

Most service disruptions are currently considered "unpredictable" because today's early warning mechanisms are triggered by problem symptoms such as high response times. These symptoms are the easiest metrics to monitor, but they're triggered only after it's too late to avoid the impact.

Accurate intelligence is timely, meaning it doesn't rely only on the symptoms of problems already occurring. It instead understands and monitors the underlying root causes of the symptoms.

For example, infrastructure components that exceed the maximum utilization capacities are one of the most common causes of unacceptable response times. Timely intelligence will interpret the logical application workload metrics in the context of this type

of knowledge about the physical resources running the workloads.

The lack of correlating logical workloads to physical resource characteristics is one of the biggest reasons IT leaders operate without good intelligence about hidden infrastructure threats. Once the root causes of a problem are understood, they can be quantified and continually monitored using key risk indicators to identify and resolve problems before production work is impacted.

This approach reduces the false positives so common with status quo alerting mechanisms. More importantly, it also avoids false negatives, which occur when no alert is given for serious issues in the infrastructure that have not yet manifested in high response times—that is, the latent issues that are not yet visible as symptoms.

The IBM z/OS* platform produces the world's richest set of enterprise computing performance and configuration data in the form of SMF and RMF*. But this data remains vastly underutilized for the purpose of identifying risk within the mainframe infrastructure. Newer approaches create useful operational intelligence by automatically identifying anomalies and correlations in the data patterns.

These approaches, however, are still focused on the symptoms of problems already occurring, and consequently, they only help staff reduce the mean time to recovery (MTTR) of problems. The ideal objective is to see and resolve the problem while the MTTR is still negative, before the service levels for a production application are ever disrupted.

Mainframe performance monitors and custom reporting mechanisms that have been in use for many years can't produce this kind of result. Only continual analysis of the logical workloads within the context of the physical resources can provide the answer. Mining the SMF and RMF data using built-in expert knowledge about the physical resources generates "availability intelligence," which IT staff can use to plan and execute a strategic response.

## Productivity Increases

When IT staffs gain access to accurate intelligence about hidden threats, they can identify, define and apply proactive performance solutions for business applications.

This source of intelligence adds a new layer of protection of continuous availability at the primary production site. This new protection will prevent many problems that currently disrupt revenue-generating applications. Additionally, time-constrained IT staffers will be more focused on creating smart solutions instead of fighting the latest fires. Not only will experienced staff be more productive, but newer mainframe IT staff members brought in to address the mainframe skills gap will more easily understand what is most important for performance and availability.

Another benefit is that critical workloads run more safely with fewer problems, often on hardware that's less expensive, so attempts to mitigate the risk of problems by overbuying expensive hardware is largely relegated to the past.

Quantifying the risk every day, on every device, in every data center, doesn't require an army of performance and capacity experts, nor does it require lengthy and expensive consulting engagements to study what new analytics are needed and develop custom reports from scratch.

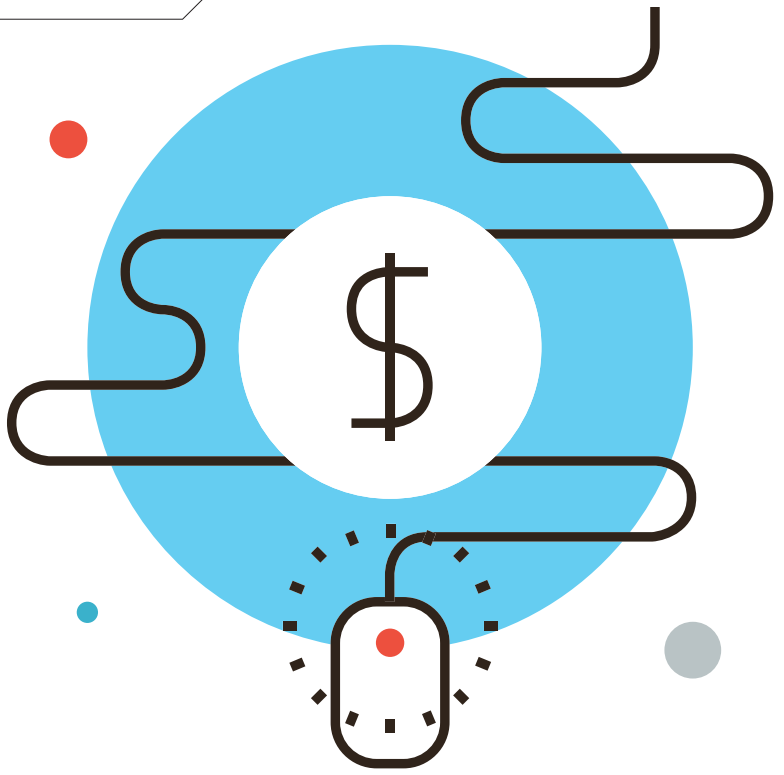
The IBM z/OS platform produces the world's richest set of enterprise computing performance and configuration data in the form of **SMF** and **RMF**, but this data remains vastly underutilized

## Health Assessments

The z/OS infrastructure configuration includes complex physical components from processors and cache to channels, disks and tape/virtual tape resources with additional components such as coupling facility or cross-system coupling facility in between. Logical infrastructure components, such as Workload Manager and synchronous and asynchronous replication and, in some cases, even automated DR swapping capabilities, are also critical parts of the IBM z Systems* ecosystem.

Many performance and configuration metrics are available in the SMF and RMF data. Understanding what it means in terms of risk for availability disruptions is only possible when it's interpreted automatically using built-in expert knowledge about the specific infrastructure components in use. The ideal solution will continually perform health assessments to automatically identify issues of unacceptably high service disruption risk. It will also rate the severity of the issue, provide views into the issue from many dimensions (physical, logical, changes from previous periods), and include recommendations on likely causes and how to remediate the risk.

With the right intelligence about infrastructure availability, IT and business leaders can have the critical visibility of threats required to mitigate hidden performance and availability problems in the IT infrastructure. The result is one of the biggest possible advances to a top IT priority: avoiding unplanned downtime for the mission-critical business applications.



# Small and EFFICIENT

## The new IBM z13s can consolidate Linux workloads at a lower cost

Earlier this year, IBM introduced the single-frame IBM z13s* to the z Systems* family. Ideal for consolidating a variety of business-critical Linux* workloads in a small footprint, it supports multiple distributions (Red Hat Enterprise Linux, SUSE Linux Enterprise Server and Ubuntu) and Linux hypervisors (z/VM* and Kernel-based VM, or KVM).

**Fehmina Merchant** is a senior consulting engineer with the IBM Competitive Project Office.

This article explains what IBM z13s offers in terms of superior Linux platform and cost competitiveness that differentiates it from x86 options in the marketplace.

### Reliable Pairing

The IBM z13s server is designed as an economical entry system that allows infrastructure consolidation and simplicity to be achieved with a Linux platform that's high performing, reliable, scalable and secure.

A fully configured IBM z13s system can have up to 20 cores, operating at 4.3 GHz and 4 TB of memory, and is capable of consolidating a large number of workloads (VMs) in a single footprint. Each z13s system can be split into up to 40 LPARs to allow workloads to be run in secure isolation within these partitions on a single box, obviating the need for separate physical systems, as would be the case on competitive platforms.

It provides capabilities to dynamically scale with capacity on demand so it can nondisruptively add resources to support varying workload demands while controlling costs. Further, with superior workload management capabilities, like other z Systems servers, the z13s enables resources to be effectively used by multiple workloads, thereby achieving the highest possible utilization of the platform.

For years, z Systems mainframes have been designed to operate with the highest levels of reliability and availability, and the z13s is no different. At the hardware level, it ships with redundant cores,

**Table 1:** Cost Model Assumptions

| Cost Elements | IBM z13s | On-premises x86-based systems | Off-premises public cloud |
|---|---|---|---|
| **Infrastructure** | **One IBM z13s system:**<br>• 8 IFLs<br>• 384 GB memory<br>• KVM hypervisor running in 1 LPAR<br>• Suse Linux Enterprise Server (SLES) as OS for workloads running in 1 LPAR<br>• IBM Storwize V7000<br>• 1.6 TB SSDs | **Two x86 systems:**<br>• 48 cores (24 cores per system)<br>• 384 GB memory (192 GB per system)<br>• KVM hypervisor running on each system<br>• SLES as OS for workloads running on 2 systems<br>• 1.6 TB internal SSDs (800 GB per system) | **24 virtual instances (in U.S. east):**<br>• 48 virtural CPUs (2 virtural CPU per instance)<br>• 192 GB memory (8 GB per instance)<br>• SLES as OS for instances<br>• 960 GB of persistent storage (20 GB per instance)<br>• Total data transfer out of 2154 GB/day<br>• Enterprise support |
| **Middleware** | **24 VMs (2 VMs per workload):**<br>• 12 VMs running WebSphere Application Server Network Deployment (ND)<br>• 12 VMs running DB2 Enterprise Server Edition | **24 VMs (2 VMs per workload):**<br>• 12 VMs running WebSphere Application Server ND<br>• 12 VMs running DB2 Enterprise Server Edition | **24 virtual instances (2 virtual instances per workload):**<br>• 12 instances running WebSphere Application Server ND<br>• 12 instances running DB2 Enterprise Server Edition |
| **Labor** | Includes costs to manage infrastructure and VMs | Includes costs to manage infrastructure and VMs | Includes costs to manage virtual instances |

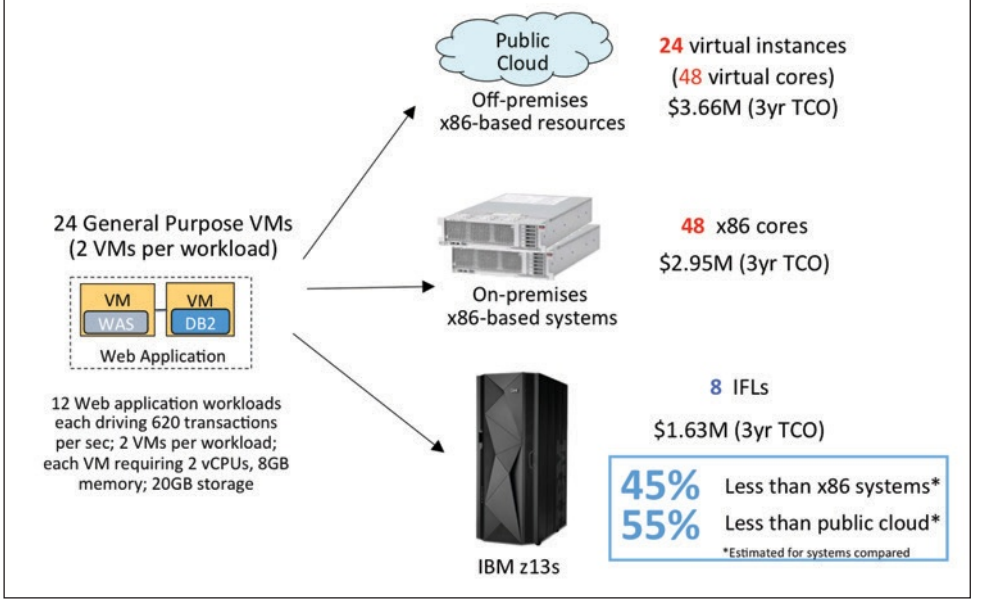
which guarantees continuous availability, even in the rare event of hardware failure. Further, redundancy in the memory subsystem is built-in using the highly available z Systems redundant array of independent memory technology. At the hypervisor level, there's support for live guest migration to help automate and speed recovery from planned and unplanned outages.

## Middleware Efficiency

With the z13s, Linux workloads can be consolidated on a smaller footprint at a lower cost compared with other x86-based options. The latest IBM total cost of ownership (TCO) study looks at the cost to consolidate Linux workloads on the z13s compared with deploying them on-premises on the leading x86 alternative or using off-premises, x86-based public cloud resources.

For this study, it's assumed there are 12 Linux Web workloads running 24-7. Each workload is a two-tier Web application consisting of two VMs, where one VM is running

**Figure 1:** Cost-Effective




LEGAL DISCLAIMER FOR FIGURE 1 (ABOVE) AND FIGURE 2 (PAGE 14)
Performance comparison based on IBM internal tests comparing IBM z13s with one comparably configured x86 environment and one comparably configured public cloud running general purpose virtual machines designed to replicate typical IBM customer workload usage in the marketplace. System configurations are based on equivalence ratios derived from IBM internal studies and are as follows: Public Cloud configuration: total of 24 general purpose instances; x86 configuration: total of two x86 systems each with 24 Intel E5-2690 v3 cores, 192 GB memory, and 2x400 GB SSDs; z13s configuration: total of 8 cores, 384 GB memory, and Storwize v7000 with 4x400 GB SSDs. Price comparison estimates based on a 3YR Total Cost of Ownership (TCO) using publicly available U.S. prices (current as of Jan. 1, 2016). Public Cloud TCO estimate includes costs (U.S. East Region) of infrastructure (instances, data out, storage, support, free tier/reserved tier discounts), middleware and labor. z13s and x86 TCO estimates include costs of infrastructure (system, memory, storage, virtualization, OS), middleware and labor. Results may vary based on actual workloads, system configurations, customer applications, queries and other variables in a production environment and may produce different results. Users of this document should verify the applicable data for their specific environment.

the front Web tier on WebSphere* Application Server Network Development, accessing data on the second VM that's deployed with the data tier on the DB2* database. Each workload is driving, on average, 620 transactions per second. All in all, 24 VMs, running a total of 12 workloads, are defined as general purpose VMs, each with two virtual CPUs, 8 GB of virtual memory and 20 GB of virtual storage.

Extensive benchmarks were conducted to determine what configurations are needed to consolidate a total of 12 Linux Web workloads (24 VMs) on z13s servers, on-premises x86 systems and off-premises public resources while meeting the service levels for the workloads in terms of desired transaction throughput and response times. In the z13s case, IBM consolidated the workloads on one LPAR using KVM with eight IFLs, 384 GB of memory and storage (IBM Storwize* V7000) of 1.6 TB while meeting all service levels. For the x86 case, workloads were deployed running KVM on two x86 systems with a total of 48 cores, 384 GB of memory and 1.6 TB of storage. For the off-premises public cloud case, the workloads could be deployed on a total of 24 instances (VMs) where each instance (VM) had two virtual CPUs, 8 GB of virtual memory and 20 GB of storage.

Based on the configurations determined from benchmarks, the costs were modeled over three years for workloads consolidated on a z13s system; on-premises, x86-based systems; and off-premises, x86-based public cloud. Various cost elements related to infrastructure, middleware and labor were included in the overall three-year TCO (see Table 1, page 12). The three-year TCO for z13s deployment is estimated to be 45 percent lower than the compared on-premises x86 deployment and 55 percent lower than the off-premises public cloud alternative (see Figure 1, page 12).

This case illustrates how lower middleware costs are a significant advantage in the

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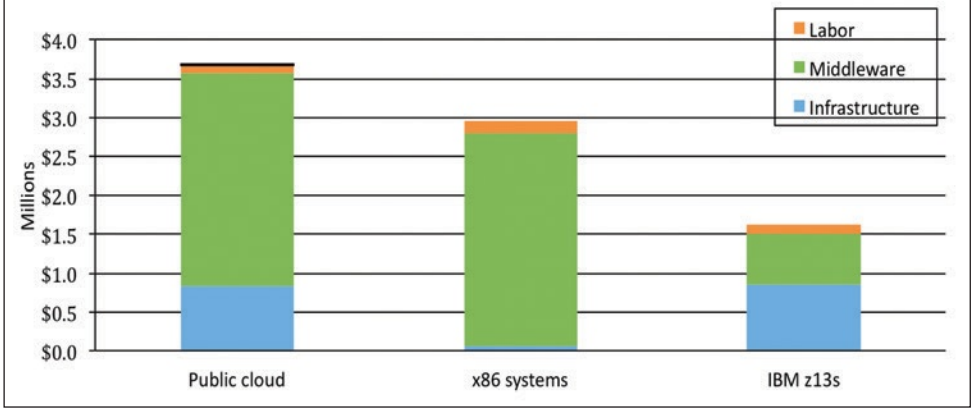
case of the IBM z13s platform in terms of overall TCO. With z13s servers, the workloads can be consolidated on a smaller footprint, which results in more than 4x lower middleware costs compared with the other two x86-based alternatives (see Figure 2, right).

Many middleware products are priced per core; therefore, consolidating on a smaller number of cores (smaller footprint) results in lower middleware costs in the case of the z13s platform. Also, a consolidated and simplified Linux infrastructure on z13s results in lower labor costs (in managing the infrastructure) compared with an on-premises, x86-based environment where a larger infrastructure (e.g., with multiple servers) needs to be managed.

**Figure 2:** Efficiency




## Competitive Price Point

The IBM z13s offers a superior enterprise-grade platform for consolidating a variety of Linux workloads at an economic price point, which will be difficult to find in competing x86-based alternatives or public cloud solutions. Z

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ILLUSTRATION BY MARK ALLEN MILLER

# BEYOND Traditional Storage

## IBM Spectrum Storage Suite offers a new way of licensing storage software

According to IDC, by 2018, storage-rich servers are expected to account for half of new capacity purchased[1]. After 18 months of working in the software-defined infrastructure (SDI) landscape, early adopters have developed a strong preference for single-vendor solutions. With the breadth of the IBM Spectrum Storage* portfolio, a logical next step for IBM was to enhance its SDI portfolio with the creation of IBM Spectrum Storage Suite. Its design is based on IBM's Virtual Storage Center (VSC) offering, which combines IBM Spectrum Control* and IBM Spectrum Virtualize* solutions running on the SAN Volume Controller appliance.

**Nick Harris** is the storage team lead in the IBM Competitive Project Office.

IBM Spectrum Storage Suite is not just a simplification of contracts, policies and procurement that comes with a bundle. It's a far more disruptive series of use cases that includes appliance software, data reduction technology, software management and transition vehicles that can be applied to the traditional storage landscape or storage for new workloads, where the actual physical storage location can be in private, public or hybrid clouds.

[1] Storage-rich server estimated growth source: Natalya Yezhkova, "Worldwide Enterprise Storage Systems Forecast, 2015–2019," Doc # 256302, IDC, May 2015. idc.com/getdoc.jsp?containerId=256302

A year after the announcement of the IBM Spectrum Storage family, the interest in SDI is high. In fact, IBM is seeing 60 percent of clients involved in early adoption committed to investing in this new technology. According to an ESG Research report, if we add clients expressing interest, we can grow the potential SDI community to over 80 percent[2].

This increased SDI desire is fueled by the rapid adoption of big data, analytics, mobile and cognitive workloads by many enterprises as they look to expand their knowledge and business advantage. Clients are building data gathering and transformation environments, and seeing a change in the form of storage. As they start to outgrow traditional storage silos in the IT landscape, storage-rich servers are being defined by the new SDI workloads as the data target of choice.

## The Suite Life

The software suite experience is not new to IT landscapes. Back in 1988, Microsoft* launched its first bundled application suite, Microsoft Office, which contained Word, Excel and PowerPoint. By doing so, it effectively created a software-defined desktop. Many have since copied this idea in various areas of the IT environment. Packaging applications in a suite doesn't prevent a la carte selections; it just delivers consistency across users and simplifies the operation and maintenance. Just like the rest of IT, this bundle of Microsoft Office applications is available in the cloud or as a hybrid environment.

The IBM Spectrum Storage family includes six software-defined storage products that can now be brought together as a suite of software:

- IBM Spectrum Accelerate*
- IBM Spectrum Archive*
- IBM Spectrum Control
- IBM Spectrum Protect*
- IBM Spectrum Scale*
- IBM Spectrum Virtualize

IBM Spectrum Storage Suite licenses are available as either a perpetual or monthly pricing model. The two models can also be combined to form what is called a utility licensing model (see Figure 1, above).

For example, a client with 500 TB of storage-area network (SAN) storage and 500 TB of storage-rich servers would license 1000 TB of IBM Spectrum Storage Suite. This provides 500 TB of a Spectrum Virtualize license, which contains virtualization (including external virtualization), IBM Real-time Compression*, FlashCopy* and IBM Remote Mirroring (including WAN acceleration).

The same client could also deploy 1000 TB of Spectrum Control software to manage this complete environment at no additional cost. Spectrum Storage Suite licensing is tied to the amount of usable physical storage being software-defined, not to the capabilities or products being deployed. IT managers have complete flexibility to deploy whatever combination of Spectrum Storage products are necessary to get the job done. The combination of Spectrum Virtualize and

**Figure 1:** Spectrum Storage Suite licensing model

| PERPETUAL | MONTHLY | UTILITY |
|---|---|---|
| • Designed for capital expenditure budgeting<br>• One-time, upfront purchase of a single license for all products<br>• Annual subscription and support fee for access to technical support and product upgrades<br>• Ideal for users with slower growing or easier-to-predict capacity needs | • Designed for operational expenditure budgeting<br>• A single license for all products, with cost per TB of storage<br>• Licensed for a specified term, usually one to 60 months<br>• License for use of software, download updates and technical support for the license term<br>• Ideal for users with rapidly growing capacity needs or who experience short-term spikes in demand | • Designed for operational expenditure budgeting<br>• Combination of perpetual and monthly style licenses:<br>• One-time, upfront purchase<br>• Per-TB and per-term licensing<br>• Ideal for service providers or others with more complex storage needs |

The capability to deploy different components of the IBM Spectrum Storage family with ease means the development and operations teams can look forward to simplified testing and fluid deployment of storage for new business solutions.

### Learn More

Find out more about IBM Spectrum Storage and IBM software-defined storage products:

**ibm.com/systems/storage/spectrum**

[2] Adoption and interest in SDS source: Mark Peters, ESG Research Report, "2015 Data Storage Market Trends," October 2015. esg-global.com/research-reports/2015-data-storage-market-trends/

Spectrum Control software includes significant data reduction technologies the client can utilize.

If we assume the client could reduce its 500 TB of managed SAN storage to 400 TB using this technology, 100 TB of managed storage would be available for the existing Spectrum Accelerate storage-rich server environment or a new Spectrum Scale or Spectrum Protect project. This capability is a unique and important aspect of the Spectrum Storage Suite license, which enables clients to evolve their storage landscapes to meet the demand as they introduce new workloads.

## Helping Clients Evolve

The IBM storage SDI model provides clients with straightforward, per-TB pricing related to their storage capacity for the entire suite—regardless of storage in use, in most cases. This licensing model is especially relevant when the client landscape is evolving and migrating from one storage or data type to another.

As this suite construction includes many products and features from the IBM Spectrum Storage portfolio, it also includes a "no software licensing hassle" to introduce these features, removing the worry of unexpected charges when attempting to use new capabilities.

The capability to deploy different components of the IBM Spectrum Storage family with ease means the development and operations teams can look forward to simplified testing and fluid deployment of storage for new business solutions. The IBM Spectrum Storage portfolio provisions a consistent UI across offerings, which further simplifies IT support.


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# ACHIEVING AN ADVANTAGE

## Linux on z Systems enables the API economy and microservices while enhancing hybrid cloud solutions

By Shirley S. Savage ➤ Illustration by James Dawe/ycn.org

Businesses are looking for technology that helps them stay relevant, flexible and secure in the digital economy. As a result, companies are turning to Linux* on z Systems* to take advantage of the platform's open-source technology that provides flexibility to meet today's challenges.

Recent acquisitions and innovations from IBM support open source and provide opportunities to leverage APIs and microservices as well as enable enterprises to effectively use hybrid cloud environments.

With foundational investments in Linux and Eclipse, IBM has supported open source and open standards for nearly two decades, notes Marcel Mitran, Distinguished Engineer and CTO of IBM LinuxONE*. IBM is also a founding member and strong supporter of several key open-source initiatives, including OpenStack, Cloud Foundry, Node Foundation and Apache Spark.

"The Linux on z Systems platform continues to be a presence in these and many more open projects, allowing IBM z* users to leverage open innovation while benefiting from the underlying platform's advantages in security, resilience, response time and scale," Mitran says. "There's a unique elegance to having the platform address these concerns."

Other platforms require heroic effort in the application and operation layers to enable security, scale and resilience, sapping energy and organizational focus from the business's core competencies and interests. But with Linux on z Systems, those advantages are built in, he notes.

Many enterprises use hybrid clouds to improve ROI. However, the ROI advantage can be lost if the hybrid cloud isn't secure. Seventy percent of enterprises investing in hybrid clouds are faced with increased security concerns.

With strong cryptography performance and an extended suite of capabilities, z Systems provides security at scale for hybrid clouds. IBM has built a rich ecosystem on z Systems with products like QRadar*, which manages and alerts clients to security threats, and IBM Security zSecure*. IBM Security Guardium* leverages analytics for data integrity monitoring. IBM has partnered with BlackRidge Technology, Forcepoint Trusted Thin Client and RSM Partners to broaden the z Systems security portfolio.

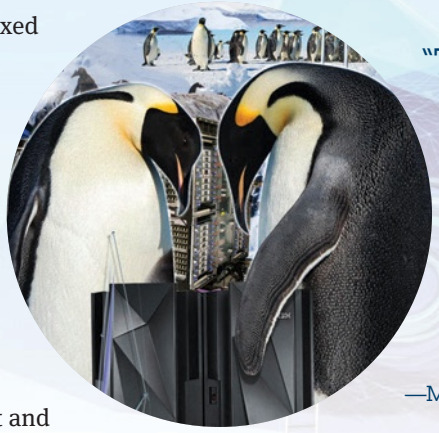
### Co-Location Benefits

Linux on z Systems hybrid cloud offers other advantages, such as co-locating with the system of record, which allows for smoother and faster performance. Application response times are up to 3x faster when the insights and engagement layers are co-located with the data.

### TAKEAWAY

- Linux on z Systems brings together open-source technology with an enterprise-grade system.
- IBM has recently made many investments to Linux on the mainframe, including acquisitions and initiatives focusing on APIs, microservices and hybrid cloud.
- Canonical's open-source platform, Ubuntu, is now available to Linux on IBM z, bringing with it cloud enablement and application development tools.

Transactions bound by fixed service-level agreements benefit immensely from co-location. When the systems processing the transaction don't wait for the data to move between discrete machines, more time exists for analytics to capture and develop insights that can provide more powerful engagement and an improved experience for the end user, Mitran notes.



"The Linux on z Systems platform continues … allowing IBM z* users to leverage open innovation while benefiting from the underlying platform's advantages in security, resilience, response time and scale."

—Marcel Mitran, Distinguished Engineer and CTO of LinuxONE

In terms of security, co-location reduces points of failure and attack vectors, which can result in better availability and security at a lower cost.

The February study by Solitaire Interglobal—"Cyber crime: Keeping data safe from security incursions" (ibm.co/1qkn1iW)—shows that z Systems requires 70 percent fewer tasks than x86 or UNIX* to implement standard protection levels, Mitran says. Therefore, securing assets on z Systems is 84 percent cheaper than on x86 or UNIX platforms, according to the study.

Co-location provides data center savings, too. Co-location and the resulting consolidation within the data center can yield a reduction in power usage and shrink the data center's footprint.

## How Ubuntu Adds Value

IBM's partnerships with open-source providers enable clients to fully explore the hybrid cloud and its business advantages. For instance, customers using Linux on z Systems for hybrid cloud applications may benefit from running Ubuntu—Canonical's open-source platform.

As a cloud-enabled distributor, Ubuntu's footprint claims 70 percent of OpenStack-enabled systems, 70 percent of public cloud images and 70 percent of Docker Hub images, Mitran says. It also has become the de facto standard distribution used by computer science and engineering graduates, he notes.

With capabilities like Juju, Metal as a Service, Landscape and LXD, Ubuntu brings a rich set of innovative and popular cloud enablement and application development tools to Linux on z Systems. "When coupled with the scale, availability and security that have made z Systems the platform of choice for some of the most demanding mission-critical systems in the world, the outcome is a very powerful value proposition," Mitran says.

Further, thanks to a common set of capabilities for both edge computing and back-end systems, Ubuntu's support of the Internet of Things (IoT) and public cloud environments provides a seamless end-to-end experience for hybrid cloud solutions.

## IBM and the API Economy

As well as partnering with companies like Canonical, IBM is acquiring businesses that offer synergies with existing IBM products and expand services for customers, such as APIs and microservices.

In September 2015, IBM acquired StrongLoop*, the leading provider of enterprise Node.js, an open-source technology that helps enterprises create, run, manage and secure APIs, explains Juan Carlos Soto, vice president of Hybrid Cloud Integration and API Economy, IBM, and former StrongLoop CEO.

Node.js is the most popular open-source framework available today. Its ecosystem has over 250,000 modules available for developers to use to create new, highly scalable applications, Soto says. Typically used for applications that must excel at handling many external connections simultaneously, Node.js is ideally suited for an enterprise's API tier. Many technology innovators take advantage of its unique technical advantages, rapid development capabilities and vibrant community.

With the acquisition of StrongLoop, IBM is expanding the category of API management solutions to not just secure and manage APIs but also to create and run APIs to deliver an unparalleled, integrated user experience supporting the full API lifecycle.

Node.js is expanding opportunities for Linux on z Systems developers on the innovative edge of open-source technology. Developers are seeing the advantages

of running APIs close to the data source itself, Soto says. Node.js runs 2x better on Linux on z Systems than on competitive platforms. Further, when Node.js is co-located with data and transactions native on z Systems, the system sees a 60 percent reduction in response times and 2.5x improvement in throughput.

"These statistics point to the power of running Node.js and implementing performance-critical APIs right on Linux on z Systems," Soto notes.

## API Connectivity

To bring IBM and Node.js synergies together, in March, IBM released IBM API Connect*, which integrates IBM's API management and gateway offerings along with API creation and runtime capabilities using StrongLoop's Node.js and IBM's Java* technologies.

"This enables companies of all sizes to create, run, manage and secure APIs that access information on existing IT systems, including the mainframe or anywhere in the back office as well as services and data in the cloud," Soto says. "It also enables high developer productivity using Node.js to create new APIs."

With its built-in, integrated support for both Java and JavaScript* (the programming language used by Node.js) for API development and execution, IBM API Connect is the only API solution on the market that covers the two most popular programming languages in a single offering, Soto notes.

APIs allow applications to interact with each other and serve data and services to mobile, rich Internet applications and IoT devices. APIs allow component services to be moved elsewhere in the cloud without breaking the overall solution, Soto says. As long as the solution uses APIs to integrate the component services, their interfaces remain consistent even as their implementation or execution locations change.

APIs also enable businesses to tap new revenue streams. Enterprises can leverage their existing IT investments and the services those investments create to drive revenue growth and expand into new business areas. For example, a bank can offer APIs to Web and mobile businesses, allowing them to use its banking APIs for transactions. "You are getting the advantage of driving new usage and creating new business opportunities from services you've built over the years," Soto says.

Companies offering APIs for external access can make them freely accessible to drive as much penetration and adoption as possible, or control access to the APIs to bill for their usage or for security reasons.

"A powerful API management platform, such as IBM API Connect, not only allows you to create and run APIs but also manage those APIs by defining access policies from the start," Soto notes. "Then, with solutions from IBM, such as IBM DataPower* Gateway, you can seamlessly enforce those data policies directly in the gateway without requiring additional programming."

Ubuntu is a cloud-enabled distributor with a footprint that claims

**70 percent**

of OpenStack-enabled systems,

**70 percent**

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Node.js runs

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better on Linux on z Systems than competitive platforms. Further, when Node.js is co-located with data and transactions that are native on z Systems, the system sees a

**60 percent**

reduction in response times and a

**2.5x**

improvement

## The Rise of Microservices

Individual APIs can also be used to create a new API tier to handle the evolving demands from mobile, rich Web and IoT. Many enterprises are creating such an API tier on the edge of their enterprise network. Rather than directly accessing data and services spread among systems of record and in the cloud, an API tier enables enterprises to combine and optimize service and data access, increasing overall performance, controlling access to back-end systems and improving overall reliability.

The API tier is increasingly implemented as a collection of microservices—each with a modular, highly specific function—exposed as managed APIs to systems of engagement. From there, developers can quickly aggregate and optimize APIs to deliver the critical services powering innovative applications accessed by customers,employees or partners.

"APIs enable companies to get into new business areas, protect their existing ones, and deliver a better experience to their customers, their partners and their employees," Soto says.

## Providing Services

Linux on z Systems supports, enables and advances hybrid cloud, the API economy and microservices as well as the business benefits these services provide. This allows your business to stay competitive and thrive in this ever-changing environment.

**Shirley S. Savage** is a Maine-based freelance writer.

# A BETTER OPTION

## Businesses see an advantage to using Linux on z Systems over scale-out servers

By Emily Farmer ➤ Illustration by Wayne Mills

The IBM z Systems* mainframe is well established today as the invaluable system of record (SoR) for mission-critical business data and applications. It has evolved over the past several decades to be the IT centerpiece of many of the largest banks, retailers, financial firms and healthcare companies in the world.

Millions of other servers are also in use. Server sprawl—driven by huge numbers of inexpensive, scale-out servers—has increased at a phenomenal rate. Since the introduction of virtualization in the mid-2000s, the number of VMs supported on those servers has also grown, with IDC reporting that x86 servers are nearing VM saturation (bit.ly/1LxnulL). Although today's most critical, complex and compute-intensive workloads are candidates for virtualization, these workloads also have ever more stringent requirements for performance and service delivery.

For instance, analytics workloads support large databases yet must also meet demand for real-time response. Large clusters of scale-out servers generally don't have the sustained performance capacity or large-scale memory and cache requirements to adequately drive these workloads—database sharding (partitioning) has become popular as a way around this issue—and the vast network connectivity requirements introduce even more latency. Mobile workloads not only put unexpected and unpredictable performance strains on IT servers, but they also demand exceptionally fast response times. As businesses move beyond simple mobile connectivity and into the API economy, co-location of systems of engagement (SoE) services with SoR assets becomes critical to maintain immediate response.

A better solution is Linux* running on z Systems. IBM z* provides exceptional performance and service delivery to efficiently drive large workloads as well as consolidate large numbers of smaller workloads. In addition, when running Linux on IBM z co-located with z/OS*, hybrid workloads that span the SoE/SoR boundary run with highest efficiency, and often with lower cost.

### TAKEAWAY

- Linux running on z Systems is a better solution than scale-out servers to run mission-critical business data and applications, as it can efficiently drive large workloads as well as consolidate large numbers of smaller workloads.
- IBM z Systems servers are designed with multiple levels of virtualization, efficiently supporting large numbers of business workloads, all in one box, with each LPAR isolated from the others and capable of running a separate hypervisor.
- One of the best methods for comparing different platforms is total cost of ownership; large-scale consolidation on IBM z will drive up utilization and reduce core requirements, thus lowering software costs.

## Performance and Service Delivery

IBM z Systems servers are far more powerful than typical scale-out models. Mainstream Intel* cores support clock speeds of roughly 2.3 to 3.5 GHz, while IBM z13* cores deliver 5.0 GHz—the fastest commercially available—and IBM z13s* cores run at 4.3 GHz. The z13 tops out at 10 TB of memory, with the z13s capable of 4 TB. Each IBM z core has over 4.3x more on-chip cache per core than an Intel core. IBM z also has shared L4 cache, which doesn't exist on Intel chips.

The impact of clock speed, memory and cache differences means that data-driven, cache-intensive, compute-intensive workloads run faster on Linux on IBM z than on x86 servers.

Database workloads are by nature very cache-intensive. IBM engineers ran a pure memory database access test on an IBM z13 with six cores running Linux. The same test produced virtually the same results on an x86-based server but required 80 cores. Because the test ran with so many fewer cores on the z13, the database software was calculated to be 6.7x more expensive on the x86 server than on Linux on z, according to IBM.

In another example, engineers at IBM Research have recently done medical-related data modeling, looking for breakthroughs in disease prevention and control. Typically, these studies use huge amounts of data and involve compute-intensive algorithms. When running these studies on large clusters of x86 servers, the data must be partitioned horizontally across the servers, and the test itself may take over a week to run because of repeated sharding and merging of the data. Alternatively, the researchers found the tests could be run in less than an hour on Linux on z Systems, primarily because the large cache and memory on the IBM z13 eliminated the need for sharding, and the faster clock speeds ran the computations faster.

Linux on IBM z is also supported by an exceptional I/O system, supporting about 80x more I/O channel processors than typical x86 servers. This means I/O intensive workloads also run faster and more efficiently on IBM z. Using data from a customer proof of concept, IBM showed that the database workload required 432 cores when running on an x86 cluster, but only 61 IFLs when running on Linux on IBM z. The configuration was calculated to have a 54 percent lower cost of acquisition.

Unlike scale-out servers, IBM z is designed with multiple levels of virtualization, efficiently supporting large numbers of business workloads, all in one box. The IBM z13 platform can support up to 85 LPARs, and the z13s up to 40. Each LPAR is completely isolated from the others, with the PR/SM* partition management functionality "baked" into the firmware. Common Criteria rates PR/SM as EAL5+, higher than any other commercially available hypervisor. Each LPAR can optionally run its own software hypervisor (z/VM* or Kernel-based VM), with each hypervisor instance supporting upward of 50 VMs running Linux. Additionally, PR/SM on IBM z is exceptionally efficient at managing system resources, ensuring high priority workloads in one LPAR will deliver to service levels, even if lower priority workloads are running in neighboring LPARs. IBM has shown that the leading x86 hypervisor can't match this service delivery when running mixed priority workloads in neighboring VMs.

IBM z13 cores deliver **5.0 GHz**—the fastest commercially available—and IBM z13s cores run at **4.3 GHz**

The z13 tops out at **10 TB** of memory, with the z13s capable of **4 TB**

IBM z is designed for resources (e.g., CPUs, memory, I/O, etc.) to be added dynamically without disruption to the running environment. This allows for a Linux platform that can scale both horizontally (new Linux VMs can be added as resources are added) and vertically (resources are added to an existing VM) (see Figure 1, page 25).

These capabilities add up to some impressive numbers—the platform is capable of driving thousands of Linux VMs and massive Linux workloads with thousands of users.

An IBM z13 running Linux was shown to support the largest single node of MongoDB, with a footprint of more than 1 TB, sustained fetch times of under 5 milliseconds and the processing of over 2 billion documents. Because this is a single massive node on the z13, sharding isn't necessary.

As evidenced by numerous real-world use cases, IBM z can support consolidation of hundreds of commodity scale-out Linux servers, with core ratios averaging around the order of 10-to-1.

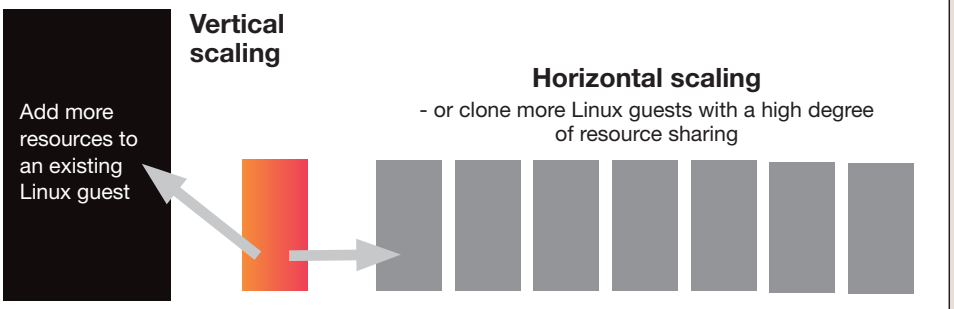
## Co-Location Advantage

Today's digital business workloads are frequently hybrid in that they have multiple components, typically serving SoR and SoE functionality. With scale-out servers, the components must span across multiple physical servers. On IBM z, they can run in neighboring LPARs, which is more advantageous because there is no physical network. LPAR-to-LPAR communication is done at memory speed over the internal HiperSockets* LAN built into the system. There's no overhead of a physical connection, thereby minimizing latency, and no physical exposure to potential security threats. This mode of communication is also transparent to the applications running.

IBM has demonstrated the advantages of co-located hybrid workloads using the IBM MobileFirst* Platform Foundation (MFPF) server—which runs on Linux—and a mobile-driven workload. When the MFPF server was co-located on Linux on z Systems with a z/OS-based CICS* core banking back end, the throughput transaction rate was twice that of when the MFPF server ran on a separate x86 server. The co-location case also delivered 31 percent lower cost per transactions per second.

In another test, an online transaction processing (OLTP) database was set up in a Linux on z Systems LPAR. An Apache Spark application was developed to run analytics queries against that database. The Spark queries were run from a separate x86 server as well as in a co-located LPAR on the same server as the OLTP database. IBM found that Spark running on IBM z with the database drove up to 3x more throughput than when Spark ran off of the platform on the x86 server.

**Figure 1:** IBM z Scaling Support




## Economic Benefit

One of the best methods for comparing different platforms is total cost of ownership (TCO), where hardware and software acquisition costs are coupled with factors like labor, facilities and power, networks, storage, non-production environments, growth plans, migration costs, availability requirements and extra security requirements. Infrastructure costs are often thought of as the most expensive part of TCO, but software costs—especially when priced per core—are often the steepest.

Large-scale consolidation on IBM z will drive up utilization and reduce core requirements, thus lowering software costs. In-house case studies have demonstrated this. A total of 123 variable workloads required 264 cores on 11 x86 servers, producing a three-year TCO of $10.6 million. On an IBM z13 system running Linux, these workloads required only 32 cores, resulting in a three-year TCO of $7.2 million, or 32 percent less. Even though the infrastructure costs of the z13 platform were about 5x more than the x86 servers, the substantial reduction in cores led to a 72 percent reduction in software costs, which brought down the entire TCO.

## Well-Rounded System

It's clear that Linux on IBM z is an outstanding alternative to scale-out x86 servers: IBM z is supported by standard distributions from Red Hat, SUSE and Canonical Ubuntu; over 3,000 Linux applications (e.g., Oracle database) from hundreds of ISVs are available for the platform; and a wide array of open-source software is supported. Furthermore, IBM internal testing has shown that Linux on z Systems outperforms x86 servers in a variety of middleware tests.

It is also a better choice than scale-out x86 servers for large cache- or I/O-intensive workloads like database applications or transaction processing, or for consolidation of large numbers of low utilization servers. Co-locating hybrid workloads on IBM z also typically delivers faster throughput and reduced costs. Lastly, with mixed workload environments, Linux on z Systems often delivers lower software license costs and overall lower TCO.

**Emily Farmer** is a z Systems evangelist in the IBM Competitive Projects Office.

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# Managing Mobilephobia

## CISOs can mitigate common mobile security fears and prevent issues in the workplace

By Eve Daniels

A human resources director forwarded some W-9 forms from his smartphone, but he sent them to the wrong person. An accounting manager's new tablet was stolen—right after she downloaded financial data for an upcoming meeting. A communications coordinator accidentally posted photos from his bachelor party to his company's Facebook page.

These scenarios would mean a bad day at work for just about anyone, but especially for a CISO. As more employees bring their own devices to and from the office, many CISOs suffer from an increasingly common anxiety disorder: mobilephobia.

IBM's e-guide, "Mobilephobia: Curing the CISO's Most Common Mobile Security Fears," delves into the worries and realities surrounding mobile security in the workplace. Jason Hardy, market segment manager for IBM Mobile Security and an author of the e-guide, explains the key takeaways CISOs can enact to improve mobile security.

A mobile device is wiped every **3 minutes** as part of a corporate security policy

### The Harsh Reality

Every three minutes, a mobile device is wiped as part of a corporate security policy, according to a recent study by MaaS360 (bit.ly/1VVRduu).

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**www.Enterprise-IT-Security.com/SafeDumpForSystemZ**

The same study revealed that businesses of all industries and sizes are clearing data from mobile devices to manage security concerns.

These facts show that CISOs have a good reason to be anxious. As the lines continue to blur between professional and personal mobile devices, new risks and threats to security arise. Unlike many phobias, mobilephobia is based on rational worries.

"We've been securing laptops and had a clearly defined perimeter for years," Hardy says, "but now there are all of these new devices that haven't been secured. Millions of people are using smartphones and other mobile devices, which means there are millions of new targets."

## Rein in Rogue Devices

In any given organization, the CISO may be struggling to manage and control hundreds or thousands of mobile devices. With those mobile devices come numerous OSes, most of which are upgraded on a regular basis, and often before the CISO has an opportunity to certify them. In addition to the OS, end users are constantly downloading new software applications that haven't gone through the company's security testing processes.

"Laptops were typically company-owned, and we were able to lock them down and manage them," Hardy says. "But mobile devices are often owned by end users—and they hold the keys to adding and upgrading applications."

To complicate matters, the providers of mobile OSes actively promote new releases. "All you have to do is push a button and there you have it," Hardy notes. "So, suddenly, the CISO has users who can put anything on their

## "Mobilephobia" Defined

In "Mobilephobia: Curing the CISO's Most Common Mobile Security Fears," the term is defined as:
A family of fears typically impacting CISOs and other security professionals associated with embracing and deploying a mobile security strategy that enables access across the enterprise, sharing of corporate data, or interaction with associates, customers and other third parties via mobile devices and applications.

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It's time that data centers get serious about their data protection and security as well as integrity obligations regarding system dump and log anonymization, and that they safeguard their SOX, PCI, DISA STIG, NIST 800-53, FISMA and HIPAA compliance.

**Dr. Stephen Fedtke**
**CTO, Enterprise-IT-Security.com**

Stephen has more than 20 years of experience in the fields of IT security, IT auditing, IT compliance and IT forensics for critical IT infrastructure. He is responsible for the development of the dump and log anonymization solution SF-SafeDump.

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device, do it cheaply and bypass any enterprise controls."

A security policy that requires that updates be pushed out automatically versus left up to each user is essential. This "over the air" policy also must identify and remediate devices that may be at risk, track who is requesting sensitive data and automate the appropriate solution.

Theft is another common way devices become "rogue." Rather than treating lost or stolen devices as an exception, they must be incorporated into the overall security plan. According to the e-guide, this starts with encryption when the device is commissioned. It also entails additional data protection for information added to the device as well as the ability to search for the device and render it harmless if it's lost.

## Separate Work From Play

To achieve the proper work-life balance, it's important to separate our professional lives from our personal lives. The same goes for mobile devices. Sometimes the biggest security threats occur when threats from personal-use apps mix with official business.

"For instance, I wouldn't want somebody taking my business content and forwarding it out through their Yahoo or Gmail account," Hardy says. "But it happens all the time."

Enter the "corporate sandbox." By creating two separate, logical partitions, it's easier for organizations to manage email, attachments and interaction among work and personal email accounts. Through this approach, organizations can stop users

[1] "The State of Mobile Security Maturity." ISMG. December 2014.

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# Why Are We Still Talking About FTP?

We all know the original mainframe FTP and FTP-to-mainframe model doesn't include basic security safeguards. Its shortcomings include clear-text transmission of security information, little granularity in access rules and no audit trail. Customers, regulators and business partners can hold you accountable for slow performance, delayed data, and lost or stolen files.

Additionally, a growing body of government regulations (Sarbanes-Oxley Act, Gramm-Leach-Bliley Act, HIPAA, PCI DSS) mandates processes for adhering to standards and providing audit trails. The limited visibility of transfers and lack of automation further compound the inadequacies of FTP use today.

Software Diversified Services recently partnered in a survey to explore the state of secure FTP in 2016. The most significant finding was that 44 percent of these participants didn't know if they would be compliant if they were audited today. Furthermore, only 28 percent of the respondents were aware of software tools that simplify and automate the migration of batch jobs from FTP to more secure technologies.

**Jim Lampi**
**Vice President,**
**Software Diversified Services**

Jim Lampi has 34 years of experience.

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**"You have all of this information coming in—millions of records—and somewhere in those records could be information pointing to a malicious attack. How do you find that one needle in the haystack?"**

**—Jason Hardy, market segment manager, IBM Mobile Security**

from forwarding attachments from corporate email systems. It's also easier to enforce authentication of the device and stop data loss and leaks.

## Boost App Security

According to Statista (bit.ly/1oNiPaL), as of July 2015, Android users could download 1.6 million apps in the leading app stores. At the same time, Apple's store offered 1.5 million apps for download.

It's nearly impossible to tell how all of those applications were developed. And, unfortunately, app breaches are one of the most common methods of hacking into a mobile device.

## Lower the Risk

To lower the risk of information from lost and stolen devices getting into the wrong hands, the e-guide "Mobilephobia: Curing the CISO's Most Common Mobile Security Fears" provides some tips. The process should include these common elements:

**Encrypt the device:** This may seem obvious, but many bring-your-own devices are not encrypted. The enrollment process must include encryption.

**Separate personal and corporate information:** The idea of containerizing, sandboxing or otherwise drawing a logical distinction between the two "personalities" provides greater protection.

**No enrollment/no access:** The key is not to position the mobile security management tools as the traffic cops between users and information but to make the enrollment process unobtrusive and simple so it happens even when users aren't forced to run scripts or download software.

**Develop an "information architecture":** Know what information must be protected at all costs and what information is less sensitive.

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# Security Breaches Have Become Commonplace

Recent mega breaches and growing compliance and audit demands have increased the need to control and manage the credentials and activities of privileged users who have unfettered access to high-value systems that store and process sensitive information.

Even as organizations work diligently to improve their cybersecurity threat postures, cybercriminals continue to develop more intricate methods to infiltrate critical infrastructure. 2015 was a banner year in terms of the multitude of tactics used to break through increasingly stronger defenses. Given these ever more sophisticated means of intrusion, organizations must implement innovative solutions to minimize their risk and ensure security due diligence.

The best way to secure your enterprise is to implement security administration, vulnerability analysis, policy enforcement, authentication (multifactor and tokenless), intrusion detection, system auditing, compliance reporting and configuration management.

The cost of security and compliance in efforts to avoid fines and penalties will help mitigate the risk of financial expenses related to a future breach.

**Brian Caskey**
**CMO,**
**Vanguard Integrity Professionals**

Brian Caskey has a 25-year track record in global marketing, corporate strategy, business development and global branding.

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[1]*Database Activity Monitoring*

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[2] "Gartner Says by 2019, 90 Percent of Organizations Will Have Personal Data on IT Systems They Don't Own or Control." Gartner. June 2013.

[3] "Average Large Enterprise Has More Than 2,000 Unsafe Mobile Apps Installed on Employee Devices." Veracode. March 2015.

Gartner says that by 2017, 75 percent of mobile security breaches result from mobile application misconfiguration (gtnr.it/1OBjq3T).

CISOs must take several measures to counteract this issue, but the first priority is to test their companies' applications for security before they're released. Why? Because unsecured applications are the biggest routes for intellectual property theft.

As noted in the e-guide, "CISOs and the IT organizations struggling with mobilephobia know that, at some point, the apps will attack. Without changing the app development, app management and security testing processes, one day some innocent little icon may lead to a whole lot of trouble."

## Control the Hordes

In our bring-your-own-device world, hordes of unmanaged mobile devices can access a company's network. They could be infected with malware or worse, and IT staff has no way of knowing.

"If you're my employee, I can deploy an enterprise mobility management solution to manage your device," Hardy says. "But if you're a business partner or affiliate, that may not be an option, so suddenly, I'm opening up access to thousands of devices I can't control."

Jailbroken or rooted devices that attempt to connect to the network present a particular threat. "These are devices that, through user tampering, have the inherent security of the

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# "I Need that 'DAM' Software!"

For many years, the absence of tools that send mainframe security event messages to distributed Security Operations Center (SOC) systems in real time has created a gaping hole. Correlating mainframe security events with other events across the enterprise is vital. With cybercriminals improving their sophistication for data exfiltration, software vendors too must step up the cyberfight. In addition to monitoring RACF*, ACF2, TSS, FTP, TCP/IP, CICS* and more, enterprises must now monitor DB2* and IMS* activity if they're really serious about securing data.

Few mainframe security vendors provide database activity monitoring (DAM) products to monitor, in real time, access to critical DB2 and IMS databases and tables that store sensitive data, such as credit cards and health records, required to be monitored for compliance purposes. However, some solutions are now available to assist with your DAM strategy and link mainframe database activity to your SIEM.

Few organizations can display mainframe events alongside their distributed events in their SOCs. Fewer are the organizations effectively monitoring DB2 and IMS activity with the capability to incorporate DB2 events into those SOCs. If you are one of these few, congratulations. If not, you really should investigate potential solutions.

**George Faucher**
**CEO, CorreLog Inc.**

Prior to joining CorreLog, George was president and CEO of SNMP Frameworks Inc., which produced an enterprise network management solution called Sentry. He has been a successful entrepreneur in IT software for over 30 years.

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> **"If your users are accessing your company through mobile, you must embrace it and get ahead of it. Mobile is here; it's happening, and you need a strategy."**
>
> —Jason Hardy

device compromised, which can expose the enterprise to mobile threats," he warns.

It's critical that the security solution can quickly identify and then limit or deny access from these devices.

"Although the device barbarians may be at the gate, organizations need to let in only those that are deemed legitimate," write the e-guide authors. "This scenario demands both access control/management and improved user authentication. Without both systems in place, things become downright scary."

## Be Proactive

Companies should create a mobile security strategy that includes five important areas:

- Protecting devices
- Securing content and collaboration
- Safeguarding applications and data
- Managing access and fraud
- Extending security intelligence

## Heed the Warning Signs

An ongoing fear is missing the warning signs about a new threat. It's easy to do, considering all of the information and media we take in on a daily basis.

"You have all of this information coming in—millions of records—and somewhere in those records could be information pointing to a malicious attack," Hardy says. "How do you find that one needle in the haystack?"

Speed and sophistication are essential. Organizations need security analytics tools that provide answers quickly. The tools must also be sophisticated enough to outsmart the hackers.

## A Holistic Cure

Ultimately, companies must take a more integrated approach to mobile security. That means creating a mobile security strategy that includes five important areas: protecting devices, securing content and collaboration, safeguarding applications and data, managing access and fraud, and extending security intelligence.

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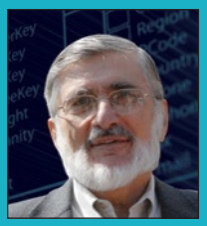
# Security Can Attract NextGen Mainframe Pros

A recent TV ad campaign features an enthusiastic new college graduate explaining that his exciting new digital tech job will literally drive the nation's transportation system. Meanwhile, his buddy's fun gig renders comic helmets on cat videos. So, how do we attract the next generation of mainframe developers when enterprise computing skills aren't top of mind for recent graduates? Through security.

Dedicated pros know the mainframe is here to stay–IBM innovations have made mainframe more efficient and cost-effective, and today's developers understand its inherent longevity. First, we must show future pros how even the coolest tech like mobile peer-to-peer payments and e-commerce systems rely on z Systems*.

But we can also promote security as a driver, even as competition for these professionals increases. U.S. News & World Report notes that IT security jobs rank eighth of the 100 best jobs through 2022 with a growth rate of 36.5 percent.

By first choosing easy-to-deploy and quick-to-master enterprise data protection tools that are automated, repeatable and affordable, security can serve as a natural entry into a still-robust computing environment.



**George Lang**
**Chairman, CTO,**
**Direct Computer Resources Inc.**

A green-screen hero in the 1970s, George developed the first-ever application testing solution for IMS*. Today, he creates data masking software for z/OS*.

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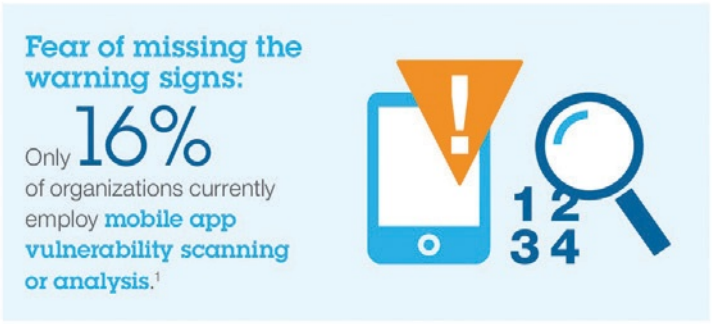


It also means choosing the right partner. IBM Mobile Security offers a complete portfolio with integrated, one-view dashboards and functionality to secure all types of endpoints and networks.

"Our main message is when you think about developing a mobile security strategy, don't think about the challenges as point problems," Hardy suggests. "Think about the full spectrum of threats, and take a holistic approach to addressing them."

He says most organizations are receiving this message well. But when mobilephobia kicks in, those same organizations can become paralyzed by fear instead of embracing mobile and implementing a comprehensive strategy. The longer they remain paralyzed, the greater their risk for threats and falling behind the competition.

"If your users are accessing your company through mobile, you must embrace it and get ahead of it," Hardy says. "Mobile is here; it's happening, and you need a strategy." Z

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**Eve Daniels** is a Minneapolis, Minnesota-based freelance writer.

## More Resources

Download the e-guide, "Mobilephobia: Curing the CISO's Most Common Mobile Security Fears": **ibm.biz/mobilephobia**

Find out how IBM Mobile Security can help secure your information: **ibm.com/security/mobile**

Stay current on analysis and insight aimed at information security professionals: **securityintelligence.com**

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# Integrating the Mainframe With Modern Identity and Access Management

For many organizations, the mainframe remains a secure platform for good reason. The z Systems* platform has historically operated in its own environment, isolated from other applications. Mainframe data has also been considered secure, travelling on a protected path using the TN3270 terminal. Traditional mainframe security practices for heritage applications are no longer sufficient to prevent against advanced security threats.

In the digital economy, mainframe security requires a more comprehensive approach. Companies can't rely on one security system to protect distributed or Web applications while using an outdated approach for its mainframe applications.

Heritage mainframe applications offering only siloed authentication with eight-character password protection and a post-attack auditing capability will not meet security requirements.

A new approach is needed—one that offers IT centralized control to effectively and proactively monitor and enforce security policies.

To achieve this, an organization must protect these applications with modern identity and access management systems. Only then can IT deliver managed security solutions to all applications, not just a few. Why protect only a subset of business apps when modern security can be extended across the enterprise?

**David Fletcher**
**Senior Solutions Marketing Manager, Host Connectivity Portfolio, Micro Focus International**

David has worked in the host access and host security market for over 16 years, diving into both technical and process.

# ENVIRONMENT Integration

## IBM DB2 on z/OS V2.2 features space and storage enhancements

This article outlines IBM DB2* enhanced capabilities with z/OS* V2.2, including easier movement and updates, more data set functions, and space and storage improvements. Part I of this article, "Database System Synergy" in the March/April issue (bit.ly/1Vif75W), highlights some of the features z/OS 2.1 provides to DB2 for z/OS.

**John Iczkovits** is a senior IT specialist with IBM Advanced Technical Support. He provides DB2 for z/OS technical support and consulting services. His areas of expertise include DB2 data sharing, performance and availability.

### Easier Movement

There was a time—long ago, when an IPL was required to add or delete an entry—when incorrectly updating the SYS1.PARMLIB subsystem name (SSN) table would require an IPL. Most customers perform IPLs with much less frequency, so it can take a while for an opportunity to occur to add a new DB2 subsystem or fix an entry for one in the SSN table. Entries can now be added dynamically, but with z/OS V2.2 you can also delete an entry using the SETSSI command.

Customers using FlashCopy* probably notice that dumping a large copy pool can take a considerable amount of time because all work is done from one LPAR. This includes dump (command, auto and fast replication) processing. z/OS V2.2 now has a new SETSYS command to distribute dump work across all hosts in a Sysplex-wide common dump queue. This allows hierarchical storage management (HSM) to distribute workloads across host members in an HSMplex, and the new architecture allows for flexible configurations. The end result is the potential for the dump process to complete faster and possibly allow for FlashCopy to be executed more often.

The class transition function in the management class debuted in z/OS V2.1, allowing transition of data between tiers and even down to the HSM migration level. For example, a DB2 partition that won't be used frequently after 100 days is transitioned from SSD/Flash or HDD to a cheaper Serial ATA device. After 365 days, transition the data set to an HSM migration level 2 tape. This enhancement allows for cheaper, more efficient use of disk and tape. With z/OS 2.1, the class transition function is limited to automatic space management processing. With z/OS V2.2, the various MIGRATE commands are enhanced to support class transitions at the data set, volume and storage group level.

Along with this change, the MIGRATE command can be used with the new STORAGEGROUP keyword to initiate migration for all volumes within a storage group in parallel. Up to 30 storage groups may be specified. This is significant for DB2 because it allows for such things as data sets in storage groups that contain image copy or archive log data sets to be created on disk and then migrated to tape via the MIGRATE STORAGEGROUP command.

### Data Set Improvements

The Data Facility Storage Management Subsystem class transition function can now move data laterally in the same tier of storage in addition to

moving it to a different tier's storage. This enhancement allows data to be moved from a smaller to a larger disk and is especially helpful when moving data to extended address volume (EAV) volumes.

Updating the expiration date of a single copy pool dump version is typically no easy task. It can take thousands of FIXCDS commands to resolve the problem. With z/OS V2.2, the UPDTCDS command will update the expiration date for a copy pool dump copy. This new command updates all of the control data set records that must be updated to reflect the new expiration date, including the fast replication dump record and the dump record for each volume dumped.

Finding HSM and data set services (DSS) messages for a specific FRBACKUP or copy pool automatic dump can be challenging—find the correct log and search through all of the messages for all HSM activity. This can be like looking for a needle in a haystack for a busy HSM. With z/OS V2.2 and DB2 12 (as a statement of direction), messages from such things as FRBACKUP and system-level backup (SLB) can be allocated to a specific data set. The output for tasks such as SLB will contain the data set name in which to find the associated messages.

HSM APAR OA47876 for z/OS V2.2 fixes a problem in the HSM interface for SLB—BACKUP SYSTEM, RESTORE SYSTEM and RECOVER. None of these utilities will work without the corresponding PTF applied.

Generation data groups (GDG) are used by almost all z/OS customers and have been around for a long time. The GDG limitation of 255 data sets prevented customers from creating data sets daily and having a year's worth of data available. With z/OS V2.2, GDG Extended (GDGE) can be created or altered to surpass 255 data sets, allowing for a maximum of 999 data sets. All LPARs sharing GDGE should be at z/OS V2.2.

IDCAMS DEFINE GDG defaults to NOSCRATCH, which can leave unwanted data sets when generation data sets (GDS) roll off. This is further complicated when users inadvertently put retention periods on their GDSes.

Systems administrators can now change this behavior and scratch data sets, even when the retention period has not yet been met. For Removable Media Manager (RMM) customers, the WHILECATALOG attribute for data sets allows users to specify whether data sets should be retained or expired by date when catalog entries for them exist. This is helpful for GDG data sets on tape. RMM customers can now use SEARCHDATASET and SEARCHVOLUME TSO commands to select records by creation date and time.

## ICF Flexibility

When DB2 customers are looking at integrated catalog facility (ICF) performance or recovery-related issues, they often want to issue reporting types of commands to the catalog address space without modifying the catalog configuration. With z/OS V2.2, a new RACF* resource profile is checked by catalog command processing to ensure the issuer of a command is authorized to execute the command (e.g., have the authority to issue command F CATALOG,ALLOCATED but not F CATALOG,CLOSE(usercat) ).

Other enhancements include the capability of DSS to restore an ICF user catalog to any volume serial number, not just where it was dumped. This applies to logical restores only. Restrictions for physical data set restore remain.

Some DB2 customers ask for an IDCAMS REPRO MERGECAT (move or copy catalog entries from one ICF user catalog to another) to be executed. The output can be enormous, as it produces up to six lines for each entry processed. New keyword MESSAGELEVEL(ALL|SHORT) provides users a short version of the output.

IDCAMS PRINT and REPRO functions can now process damaged VSAM control intervals or records using new keyword CIMODE.

## Space Allocation

Storage Management Subsystem (SMS) has a handy feature in the data class called Space Constraint Relief (SCR). If the storage group doesn't have enough space for a request on any volume, the requested space is reduced by the Interactive Storage Management Facility value Reduce Space Up To (%). For example, if SCR is set to 10 percent and a DB2 data set would like to allocate 1,000 cylinders, but no volume in the storage group has 1,000 cylinders free, the request is automatically redriven at 900 cylinders. With z/OS V2.2, this feature applies to data sets with the storage class specification of guaranteed space as well. A new sub-parameter, Guaranteed Space Reduction (Y|N), is added to the data class panel. Although DB2 user data sets generally shouldn't have guaranteed space specified, this allows for the possibility of fewer space-related failures when specified.

SCR can also be used for secondary space allocations. Prior to z/OS V2.2, if a secondary space request was for 100 cylinders and the volume didn't have 100 cylinders, we hit the End of Volume command and chose another volume to extend to. With z/OS V2.2, we also use SCR for extents to reduce the 100 cylinders to the SCR value. In our scenario, with the 100 cylinders secondary request and an SCR of 40 percent, the allocation can be anything at or above 60 cylinders and can vary from time to time. If reduced, the allocation may be 60 cylinders, and at other times 90 cylinders, but not below 60 cylinders in this scenario. This support is for SMS-managed, non-striped VSAM data sets and non-VSAM data sets.

From time to time, DB2 customers may see space-related information in the DBM1 STC or other output, such as IDCAMS-related output. This message states that the cumulative space allocated on the selected storage group has exceeded HIGH value: IGD17380I STORAGE GROUP (sgname) IS ESTIMATED AT xx% OF CAPACITY, WHICH EXCEEDS ITS HIGH ALLOCATION THRESHOLD OF zz%. SMS now allows you to specify new storage group space warning thresholds separately from the high allocation threshold. New alert messages IGD400I and IGD401I will be issued to the console at an incremental interval when the alert threshold has been reached. IGD401I is issued only for volumes in a storage group containing one or more EAV volumes. This allows DB2 customers to set a lower threshold for warning messages, which can provide more time to react to storage group space shortage conditions.

z/OS command D SMS has a new ALERT keyword that displays any storage group that has reached either the total space alert threshold or the track-managed alert threshold. This allows for added insurance when the high-exceeded messages are overlooked.

Storage administrators sometimes struggle to keep the automatic class selection (ACS) routines in relative synch between test and production environments. SMS now provides a user-defined ACS read-only variable USER_ACSVAR used in SYS1.

PARMLIB(IGDSMSxx) as well as in the ACS routines. This allows storage administrators to have one set of ACS routines but change USER_ACSVAR depending on the environment. This enhancement potentially results in fewer errors between environments due to ACS routine differences.

## Storage Updates

Many IBM disk customers use Easy Tier* to manage data both between tiers and laterally within a tier. Executing a DB2 REORG in a tiered environment caused problems. For example, some of the data set resided on an SSD, and some on an HDD; after the REORG we begin the learning curve again and start at the HDD level. z/OS 2.2 allows for DB2-related hints so this type of scenario doesn't occur. DB2 10 for z/OS and higher can take advantage of this enhancement, which can be retrofitted to z/OS 2.1 with an APAR.

Several other storage-related features are included in z/OS 2.2 for Peer-to-Peer Remote Copy (PPRC)/Metro Mirror, such as Multi-Target PPRC, which allows a single volume to be the source for more than one PPRC relationship, and IBM zHyperWrite*: DS8870 Log Write Accelerator for DB2, a new technology that combines DS8000* and z/OS enhancements that deliver performance benefits for writing operations to DB2 logs in the Metro Mirror (PPRC) environment. This reduces latency overhead, compared with normal storage-based synchronous mirroring.

With z/OS 2.2 and storage, incremental FlashCopy supports up to 12 targets, instead of support of one for incremental FlashCopy for any individual volume. This prevents the need to define z/OS Global Mirror workload-based write pacing on a per-volume level, allowing greater flexibility in configurations. Some of these changes have also been retrofitted into previous z/OS versions.

## Enhanced Environments

We have come a long way with z/OS, and 2.2 offers great features and enhancements to manage environments. Legacy systems will benefit, as will integrating with the mobile and cloud environments on a z/OS system. z/OS has a bright future to continue to be a leader in technology.


IBM Systems MAGAZINE WEBINAR

(E)JES System Management Software: More with Less for Less

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PHOENIX Software International®

WHEN

Thursday, May 26
10 PT / Noon CT / 1 ET

AGENDA

This session will provide an overview of (E)JES—an industry-leading job management product that provides a rich set of interactive and programmable interfaces for accessing JES-oriented resources in z/OS while leveraging the latest z Systems technology to enhance performance and reduce hardware and software costs. Through slides and product demonstrations, the speaker will present the functions, features and focus areas for the current release with an in-depth look at the technology behind (E)JES Web.

FEATURED SPEAKER

Edward Jaffe
Chief Technology Officer
Phoenix Software

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# DOUBLING Security Efforts

## IBM Multi-Factor Authentication for z/OS helps maintain a secure infrastructure

An explosion of malicious attacks of increasing sophistication on computer systems has occurred recently. According to the "IBM 2015 Cyber Security Intelligence Index" (ibm.co/1QGPpSu), in 2014, unauthorized access topped the list of incident categories affecting the top five industries named in this report, comprising about 37 percent of total incidents. The increased use of low-cost and powerful password cracking systems has made attacks much easier, placing the burden on organizations to increase their levels of defense.

**Barbara Sannerud** is responsible for z Systems Enablement and has 25 years of industry experience in servers, software and services, with a focus on risk and security management.

**John Petreshock,** project management professional, is z Systems security offering manager with 19 years of experience covering development, test and product management focusing on z Systems security.

IBM Multi-Factor Authentication (MFA) for z/OS* provides a way to raise the assurance level of user authentication to z/OS applications and hosting environments by allowing the use of multiple authentication factors.

IBM MFA for z/OS is tightly integrated with z/OS Security Server (RACF*), which stores configuration and provisioning data, and provides an SMF audit trail to track authentication factors. IBM MFA can also help provide security administrators with the ability to enforce a granular authentication policy on a per-user basis.

Nearly 60 percent of security leaders interviewed in a 2014 IBM CISO assessment claim that the sophistication of attackers was outstripping the sophistication of their organizations' defenses (ibm.co/1pbkJl6). More than 80 percent of security leaders have seen external threat increases in the past three years, and it's currently viewed as a top challenge (see Figure 1, page 46). In addition, regulations such as PCI DSS and government ID cards are driving the need for MFA as a requirement for compliance.

Mobile and cloud architectures make it imperative to reduce the risk of external threats, raising questions about the adequacy of password protection. Many passwords use common defaults that are easily guessed. Password vulnerabilities were named in several high profile hacks in recent years, and the 2014 Verizon Data Breach Investigation Report (vz.to/1LUXJRR) states that use of stolen credentials has become a top threat, where 95 percent of incidents involve harvesting credentials stolen from customer devices and logging into Web applications with them. More than 1 billion personal data records were reported stolen in 2014 alone, most of which contained user passwords (ibm.co/1UNZ3aW).

### Multifactor Authentication Explained

Three factors are identified as the cornerstone of authentication:

1. Something you know (e.g., a password)
2. Something you have (e.g., a one-time password or a cryptographic key)
3. Something you are (e.g., a fingerprint or other biometric data)

The multifactor authentication method refers to the use of more than one of the aforementioned factors.

*—NIST publication SP 800-63-1*

IBM MFA for z/OS provides an additional tier of defense for authentication, reducing the likelihood that the perpetrator will have two or more factors lined up to gain access to critical systems.

## Various Credentials Needed

MFA is a popular, agreed-upon method that uses a multitiered defense system to inhibit unauthenticated users from successfully accessing secured data or other assets. It combines several credentials, typically something the user knows and has, to provide additional tiers of defense (see "Multifactor Authentication Explained," page 44). With MFA, if one layer is compromised, other layers remain in place, presenting additional barriers to access. Multiple factors are possible; biometric data, such as fingerprint readers, can serve as another layer of defense. With the adoption of MFA, banks and financial institutions have increased confidence that only authorized users can access private, confidential data.

## IBM's Implementation

IBM MFA requires z/OS V2.1 or V2.2 and RSA Authentication Manager 8.1. IBM MFA for z/OS and RACF are designed to support both hardware- and software-based RSA SecurID tokens. By extending the RACF to enable multiple authentication factors, security administrators can enforce a granular multifactor authentication policy on a per-user-ID basis.

Applications can support MFA as part of their existing RACF authentication process. MFA is integrated with System Authorization Facility and the RACF. When a user authenticates MFA with hard or soft tokens, the RSA Authentication Manager determines whether the user's credentials are valid. If they are, MFA then returns control to RACF to resume the authentication and authorization process. The solution is extensible, and as new authentication factors become available they can be added without requiring changes to the base infrastructure.

MFA support introduces extensions to a variety of


IBM Systems MAGAZINE WEBINAR

**Is Your Mainframe Infrastructure Ready for Java on z/OS?**

**Wednesday, May 11**
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bmc

Your company has adopted Java. Now what? Do you know how Java is impacting your mainframe infrastructure performance, availability and capacity across your mainframe subsystems?

Because Java doesn't follow the same rules as traditional COBOL applications, it's increasing the complexity and can cause chaos on the mainframe if left unmonitored. As the number of Java deployments increases on z/OS, it's even more crucial to understand which Java Virtual Machines (JVMs) are running and understand how they are impacting the performance, availability and capacity across your mainframe subsystems.

Join BMC mainframe expert Jay Lipovich for this special webinar to learn important new strategies for Java Infrastructure Management.

Topics will include:

- Challenges to monitor Java on z/OS
- How to reduce your MTTR with an integrated monitoring solution that can quickly identify performance issues caused by JVMs
- How to optimize and manage your zIIP offloading to maximize your Java investment

***FEATURING:***

**Jay Lipovich**
Principal Product Manager - Mainframe Solutions Optimization
BMC Software

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components in RACF. For instance, it stores MFA fields in user and resource profiles managed by new RACF commands and callable services. The RACF database serves as the data repository for MFA data for auditing and reporting purposes. Simple user commands allow the provisioning and definition of the acceptable tokens for a user. Tokens can be specified during user authentication requests, enabling MFA-aware applications to allow for factors in addition to RACF passwords. Auditing extensions track which factors were actually used during the authentication process.

## Phased Approach

IBM delivered MFA enhancements in phases, beginning in February. The first MFA solution involved the use of RSA SecurID Tokens—hardware or software—that require an RSA SecurID server configured to the MFA server. SecurID Software tokens use the same algorithm used in popular RSA SecurID hardware tokens. (Many companies may find that the use of software tokens may be preferable to key fobs, however, as there are fewer physical assets to manage, and it's easier to provision or de-provision users with software tokens.) The RSA SecurID solution requires the licensing of the RSA Secured Server, which can run on an x86-based platform. RSA tokens are available for a number of mobile platforms as well.

In addition to the RSA support, IBM issued a statement of direction for future authentication factors and additional ecosystem support[1]:

**Figure 1:** Biggest Challenges

More than **1 billion** personal data records were reported stolen in 2014 alone, most of which contained user passwords

1. The IBM TouchToken authentication, a Timed One Time use Password (TOTP) generator that enables strong authentication for iOS environments. The TOTP is evaluated on z/OS directly to ensure two-factor authentication is enforced.
2. Personal Identity Verification/ Common Access Cards frequently used in government applications will be included.
3. zSecure* support is intended to simplify administration by helping to enforce authentication policy, providing alert notifications and reporting on authentication audit events and compliance.

## Protection Today and Tomorrow

IBM offers a highly flexible solution with RSA soft and hard token support. Multiple authentication methods are designed to be supported, and tight integration with RACF provides a consistent, policy-based, auditable approach.

IBM MFA for z/OS can help clients accelerate deployment, simplify management and more easily address regulatory compliance.

It can be used to secure mission-critical applications today as well as provide needed authentication to protect new mobile and cloud applications going forward.

[1] IBM's statements regarding its plans, directions and intent are subject to change or withdrawal without notice at IBM's sole discretion.

# SOLUTIONS

Illustration by Charles Williams

## Universal Data Manager
Dino-Software

Dino-Software Corp. announces the availability of its latest software innovation, Universal Data Manager, to simplify the management of today's complex mainframe storage environments, both in improved storage utilization and speed of control for the entire enterprise from a centralized GUI. Features include:

- Capability to easily manage, monitor, report on and maintain enterprise z/OS* storage from a centralized GUI with a global view
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- Capability to run a single command or job executed on all controlled systems, eliminating typical task and command library redundancies
- Extensive reports using SQL filtering that can be generated, saved and executed on multiple systems in a single request, with output from all systems returned into the single GUI window
- Message trapping and scheduling to ensure storage management can be automated as required and enable proactive alerting when critical storage conditions occur
- Quick installation for immediate utilization and return on investment, fitting seamlessly into any data center, thanks to its flexible architecture

**OS SUPPORT:** z/OS 1.12 and above
**PRICE:** Variable
**URL:** dino-software.com

## OpenLegacy V3.0
OpenLegacy

OpenLegacy announces its latest release, OpenLegacy V3.0, for rapid, secure and flexible API generation integration and delivery. Benefits include:

- A compiled API approach for security, flexibility and performance
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- API management, including lifecycle management and version control using any Eclipse-compatible tool
- Enhanced security features, such as OAuth, data filtering and a dedicated secure gateway

**OS SUPPORT:** Windows* XP and above, Linux*
**PRICE:** Variable
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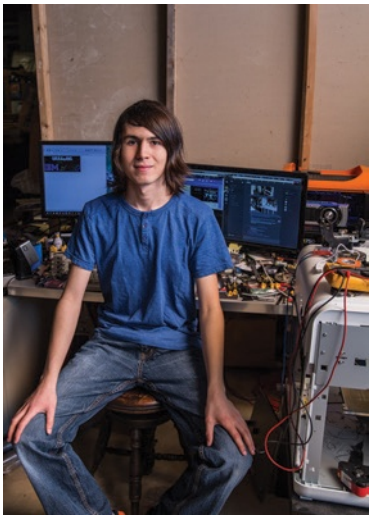
## A Gen Z Mainframe Adventure

### 19-year-old installs a z890 in his parents' basement

**Gabe Goldberg** has developed, worked with and written about technology for decades.



Connor Krukosky's love for vintage machines led to him purchasing an IBM z890.

PHOTOGRAPHY BY JOHN DAVIS

Today's typical young adults are occupied with things like sports, arts, online/mobile games, social media apps and fashion. But Connor Krukosky isn't your typical Gen Zer—he has a mainframe in his parents' basement.

An aspiring electrical engineer, 19-year-old Krukosky acquired his first computer—what he believes is an IBM Aptiva—when he was 18 months old and started collecting vintage machines about three years ago. In October 2015, a note on the members' list of the then-named Mid-Atlantic Retro Computing Hobbyists group (yhoo.it/1nWefWB) announced, "IBM z890—Model 2086-320; bidding so far $100," and he was hooked. Krukosky replied that he needed something to heat his basement and would definitely go for it.

Moving the mainframe into the basement.

PHOTO COURTESY OF CONNOR KRUKOSKY

Skeptics noted the system's doorway-busting size and weight of over 1 ton, but he bid and the beast was his for a mere $237.39.

The move included stripping everything from the z890 frame, using the family's small flatbed trailer to transport it home and his supportive father excavating under their deck to slide the tight-fitting frame into the basement.

Reassembly involved replacing damaged heatsink thermal compound, rewiring the z890 from three-phase to single-phase and configuring the home's power panel for 220 volts. Hours of self-study and abundant advice from members of the IBM-MAIN discussion mailing list helped create an I/O configuration data set and define a new LPAR. Then came the need for storage, with fiber connectivity (FICON*)/ESCON gear too expensive and bus and tag storage too hard to get. The solution was an IBM storage-area network (SAN) Data Gateway for storage; Linux* is installed but not yet running.

After all that, the big VM or OS IPL hasn't yet happened. Fundamental Software (funsoft.com) is lending a FLEX-ES Control Unit Behavior ESCON emulator.

An educated guess for the system's original cost, a 2086-320 model with 8 GB of memory and appropriate I/O gear, was about $340,000. Krukosky's total project cost so far is about $340, including thermal adhesive epoxy, cables, the SAN gateway ($11.84), etc., representing 0.1 percent of the cost of the new machine.

IBMers have been informally helpful, and Krukosky is exploring whether z/VM* and z/OS* versions might run. Next comes Internet accessibility via a 3270 SSH and a 3270 terminal via a 3174-61R establishment controller.

With Krukosky representing the next mainframe generation, IBM z Systems* servers are in good hands for years to come.

### About the IBM z890

Introduced April 7, 2004—the 40th anniversary of the System/360 mainframe—the z890 server replaced the z800 and allowed mid-size enterprise customers an option based on the z990 technology. Read more about the z890 in the System Overview: ibm.co/1PFrbaw.

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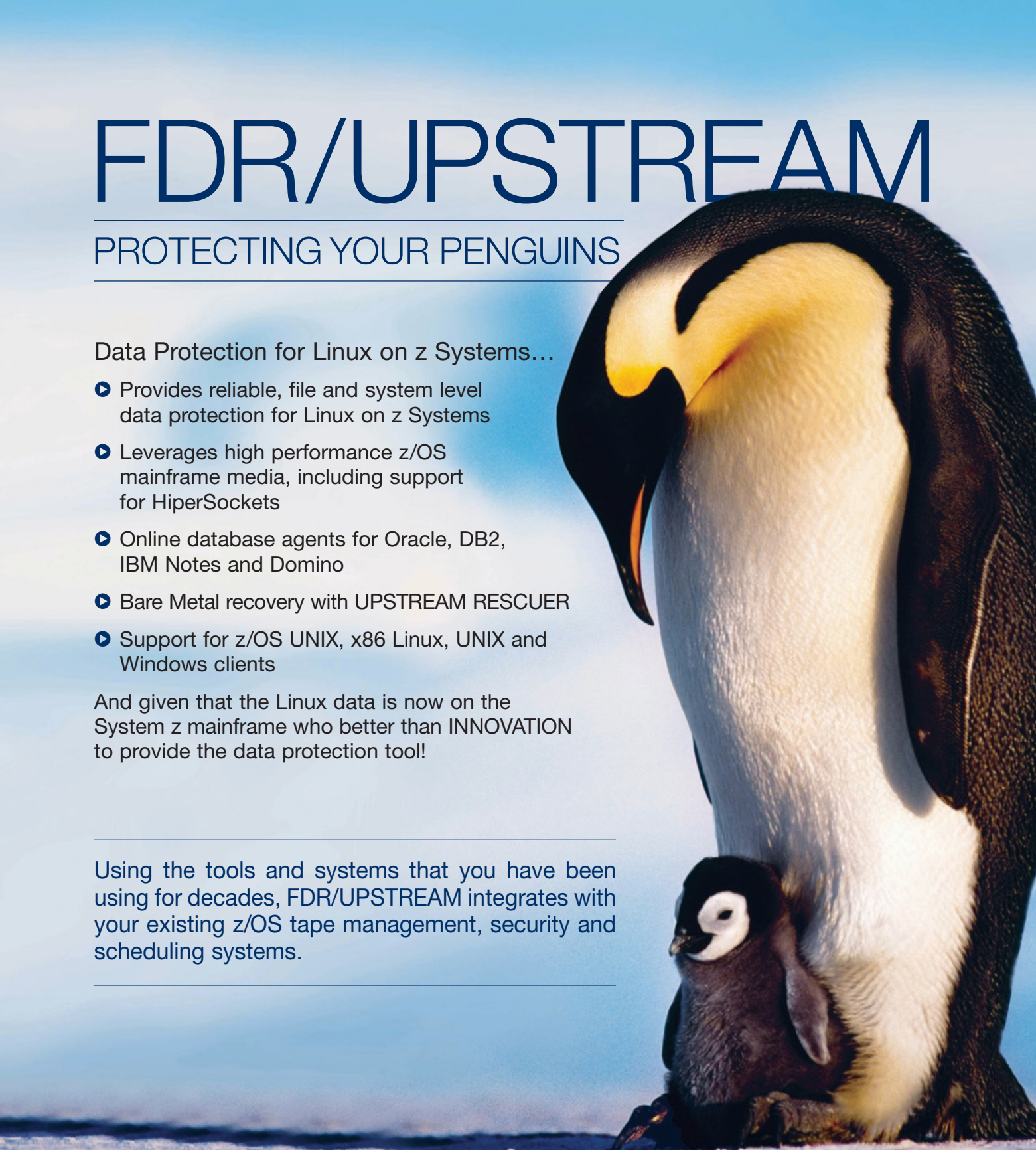

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**z/XDC (Extended Debugging Controller)**
ibmsystemsmag.com/buyersguide/colesoft

**Printer Support**
**General (Administrator)**
**OMC Output Management Center**
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**Supply Chain**
**General (Administrator)**
**Explorer GUI**
ibmsystemsmag.com/buyersguide/dtssoftware

**Monitor**
ibmsystemsmag.com/buyersguide/dtssoftware

**Systems Management**
**Backup (Administrator)**
**FDRSOS network-free DR protection for your Linux on z Systems cloud**
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**FDR/UPSTREAM for Linux on z Systems**
ibmsystemsmag.com/buyersguide/innovation

**FDR/UPSTREAM z/OS data protection for your open-systems cloud**
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**SOSINSTANT nondisruptive z System DR protection for your Linux on z Systems cloud**
ibmsystemsmag.com/buyersguide/innovation

**TapeSTREAM Virtual Tape Solution**
ibmsystemsmag.com/buyersguide/fischerinternational

**Compliance**
**eventACTION**
ibmsystemsmag.com/buyersguide/actionsoftware

**ussACTION**
ibmsystemsmag.com/buyersguide/actionsoftware

**Disaster Recovery**
**Recoverability Assessment Service**
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**UPSTREAM/SOS network-free, file-level protection for your Linux on z Systems cloud**
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**UPSTREAM RESERVOIR for distributed open-systems cloud data protection**
ibmsystemsmag.com/buyersguide/innovation

**VFI**
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## General

**Vanguard Professional Services**
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**Vanguard Security and Compliance Solutions**
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**Vanguard Staff Augmentation Services**
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## General (Administrator)

**DLm Control Center (DCC)**
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**EASY/Exit**
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**FDRViEWS**
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**Serena ChangeMan SSM**
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**SMS/Debug**
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**Space Recovery System (SRS)**
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**SUSE Manager**
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**VitalSigns**
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## General (Developer)

**Hiperstation**
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**Xpediter**
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## Help Desk (Administrator)

**ReACT**
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## Job Management

**IOF JES2 Job Management**
ibmsystemsmag.com/buyersguide/fischerinternational

**zOSEM HSM Reporting and Optimizer**
ibmsystemsmag.com/buyersguide/trident

## Job Scheduling

**zOSEM for Software Cost Reduction**
ibmsystemsmag.com/buyersguide/trident

## Performance (Administrator)

**EasySMF**
ibmsystemsmag.com/buyersguide/blackhillsoftware

**HostBridge for zIIP**
ibmsystemsmag.com/buyersguide/hostbridge

**HostBridge Socket Support**
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**IAM and IAM/PLEX**
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**IntelliMagic Direction for z/OS**
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**IntelliMagic Vision for z/OS**
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**JavaSMF**
ibmsystemsmag.com/buyersguide/blackhillsoftware

**zDynaCap**
ibmsystemsmag.com/buyersguide/sds

## Report Management

**JES2Mail / JES2FTP**
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## Security

**Data Encryption Facility (DEF)**
ibmsystemsmag.com/buyersguide/appliedsoftware

**Vanguard Governance Risk and Compliance Software**
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**Vanguard Identity and Access Management Software**
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## Security (Administrator)

**Absolute Proof**
ibmsystemsmag.com/buyersguide/fischerinternational

**CorreLog dbDefender for DB2**
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**CorreLog SIEM Agent for IBM z/OS Mainframes**
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**CorreLog Visualizer for IBM z/OS**
ibmsystemsmag.com/buyersguide/correlog

**ERQ – Easy RACF Query**
ibmsystemsmag.com/buyersguide/aspg

**FDRERASE for z/OS**
ibmsystemsmag.com/buyersguide/innovation

### Security/Encryption
**MegaCryption**
ibmsystemsmag.com/buyersguide/aspg

### Spool File Management
**OMC-FLASH**
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### Storage Management
**SpaceFinder Storage Management Solutions**
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**Total Storage**
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### Tape Migration
**Migration in Place**
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**Tape/Assist**
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### Tape Management
**FATSCOPY**
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**IntelliMagic Vision for z/OS Tape and Virtual Tape**
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## Tools and Utilities
### General
**TSO Superset Utilities**
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### General (Developer)
**DYNA-STEP**
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**STEPLIB-Rx**
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**ThruPut Manager**
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## Education
### Classroom
### General
**Vanguard Security and Compliance Training**
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## Services
### Consulting
### General (Trends)
**z/OS Systems Consulting**
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